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30 May 2000

INTELLECTUAL PROPERTY LAW

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Attorney Docket: P56102

Sir:

Submitted herewith is the following patent application:

Inventor: 1) CHANG-ROK LEE
 2) CHUL-MIN KIM

Title: APPARATUS AND METHOD FOR CONTROLLING COPY OF
 VIDEO SIGNAL

Please find attached hereto an application for patent which includes: Specification and Abstract, Claims, original Declaration And Power of Attorney, Assignment, and a certified copy of the foreign priority document identified below:

Verified Showing of Small Entity Status: **NO**

Drawings: Formal drawings, 5 sheets, Figures 1A-5

Claim of priority under 35 U.S.C. §119: **YES**

** The Republic Of Korea Application No. 19771/1999 filed on 31 May 1999.

FEE (see formula below): CHECK IS NOT ENCLOSED

Basic Fee \$345/690 **\$690.00**

Additional Fees:

Total number of claims in excess of 20: ____ times \$9/18 . **\$0.00**

Number of independent claims in excess of 3: 3 times \$39/78 **\$234.00**

Multiple Dependent Claims \$130/260 **\$0.00**

An Assignment is likewise enclosed: Recording Fee \$40 . . **\$0.00**

Filing Non-English specification **\$0.00**

TOTAL FEES FOR THE ABOVE APPLICATION **\$924.00**

Assistant Commissioner for Patents
30 May 2000
Page Two

Docket No.: P56102

Inventor: 1) CHANG-ROK LEE
 2) CHUL-MIN KIM


Title: APPARATUS AND METHOD FOR CONTROLLING COPY OF
 VIDEO SIGNAL

In view of the above, it is requested that this application be accorded a filing date pursuant to 37 CFR 1.53(b).

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Respectfully submitted,



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TITLE

**APPARATUS AND METHOD FOR CONTROLLING COPY OF VIDEO
SIGNAL**

CLAIM OF PRIORITY

This application makes reference to, incorporates the same herein, and claims all benefits accruing under 35 U.S.C. §119 from my application *APPARATUS AND METHOD FOR CONTROLLING COPY OF VIDEO SIGNAL* filed with the Korean Industrial Property Office on 31 May 1999 and there duly assigned Serial No. 19771/1999.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a video signal recording/reproducing apparatus and method, and more particularly to an apparatus and method for controlling copying of a video signal, when the material ("content") embodied in the signal is copy-protected.

Description of the Related Art

To protect copyrights, generally, a video cassette recorder (VCR), which is a video recording/reproducing apparatus, embeds a macrovision signal. This is an automatic gain control (AGC) pulse in an interval between the 12th and the 19th horizontal synchronizing

1 signals of the first field of a composite synchronizing signal and in an interval between the
2 275th and the 282nd horizontal synchronizing signals of the second field of the composite
3 synchronizing signal, as shown in Figs. 1A and 1B.

4 According to conventional technology, when a video signal including such a
5 macrovision signal is recorded, AGC is performed during the video recording signal
6 processing. Thus, the video level is automatically adjusted on the basis of the macrovision
7 signal during recording, so that the level of the video signal is greatly reduced. Accordingly,
8 when reproducing a recorded video signal having a macrovision signal, the level of the video
9 signal is very low in an interval in which the macro vision signal is recorded. That causes
10 it to be difficult to recognize an image. In this manner, illegal copying of protected content
11 of video tapes has been prevented.

12 As described above, the conventional technology has the disadvantage that it cannot
13 be known that a tape to be copied is copy-protected until the tape is attempted to be copied
14 in a normal recording mode, and then the copied tape is reproduced. In addition, in the case
15 of FM copying by a dual deck VCR, normal copy is achieved. Consequently, infringement
16 of copyrights can occur, because a macrovision signal cannot be detected with conventional
17 technology in the FM copy mode.

18 SUMMARY OF THE INVENTION

19 To solve the above problem, an object of the present invention is to provide an

apparatus and method for controlling copy of a video signal, to detect whether a recording medium to be copied includes a copy preventing signal (a macrovision signal). Related objects of the invention and preventing illegal copying, not performing in a recording mode when the recording medium includes a copy-preventing signal, and informing a user of such facts.

To achieve the above objects, the present invention provides an apparatus for controlling copying according to the standard of a video signal to be recorded. The apparatus includes a video signal processor for separating a composite synchronizing signal from the input video signal to be recorded, and for modulating or demodulating the video signal; a detector for receiving the composite synchronizing signal and detecting a copy preventing signal; and a controller for generating a recording prevention control signal to stop a recording mode when a copy-preventing signal is detected by the detector.

The present invention also provides a method for controlling copy according to the standard of a video signal to be recorded. The method includes the steps of (a) determining whether a copy command is input, (b) comparing a time T_1 read from a timer with a threshold value T_0 set at an initial stage when it is determined that the copy command is input in the step (a), (c) determining whether a copy-preventing signal is detected from the video signal to be recorded when it is determined that $T_1 \geq T_0$ in step (b); and (d) stopping a copy mode when it is determined that a copy-preventing signal is detected from the video signal in step (c).

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention, and many of the attendant advantages, thereof, will be readily apparent as the same becomes better understood by reference to the following detailed description when considered in conjunction with the accompanying drawings in which like reference symbols indicate the same or similar components, wherein:

Figs. 1A and 1B illustrate macrovision signals added to a video signal;

Fig. 2 is a diagram illustrating the configuration of an apparatus for controlling copy of a video signal according to the present invention;

Fig. 3 is a flowchart of a determination method performed by the detector of Fig. 2;

Fig. 4 is a diagram illustrating the configuration of a dual deck video cassette recorder (VCR) to which the present invention is applied; and

Fig. 5 is a flowchart of a method for controlling copy according to the present invention in a dual deck VCR.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Fig. 2, an apparatus for controlling copy of a video signal. includes tuner/modulator (T/M) block 201, audio/video (A/V) switching unit 202, video signal processor 203, detector 204, and controller 205.

T/M block 201 separately outputs the video signal and the audio signal of a channel which is selected by a user from among broadcast signals input through an RF input terminal

1 or outputs a signal input from a video/audio jack input terminal directly through a line.

2 A/V switching unit 202 separately outputs the video signal and the audio signal input
3 from T/M block 201 to corresponding signal processing blocks. In other words, the video
4 signal is output to video signal processor 203, and the audio signal is output to an audio
5 signal processing block (not shown).

6 In a recording mode, video signal processor 203 separates the input video signal into
7 a luminance signal and a color signal, and frequency-modulates and low-band-frequency
8 converts the luminance and color signals. In a reproducing mode, video signal processor 203
9 separates a modulated input video signal into a luminance signal and a color signal, and
10 demodulates the luminance and color signals. Video signal processor 203 also separates a
11 vertical/horizontal synchronizing signal from an input video signal and outputs it as a
12 composite synchronizing signal.

13 Detector 204 receives the composite synchronizing signal and detects and outputs a
14 macrovision signal which is a copy-preventing signal. Detector 204 thus acts as a means for
15 receiving the composite synchronizing signal and detecting a copy-preventing signal.

16 Controller 205 counts the horizontal synchronizing signals of the composite
17 synchronizing signal to generate a masking pulse for slicing an interval between the 12th and
18 the 19th horizontal synchronizing signals of a first field and an interval between the 275th and
19 the 282nd horizontal synchronizing signals of a second field, on which the macrovision signal
20 is loaded. When the controller 205 receives information that a macrovision signal is detected

from the detector 204, it generates a recording prevention control signal for stopping a recording mode and, simultaneously, generates a display control signal for displaying an on-screen display message that a tape to be copied is a recording medium protected against illegal copy. A pulse generator unit for generating a masking pulse which is generated by controller 205 above may be included in detector 204. Controller 205 thus acts as a means for generating a recording-prevention control signal adapted to stop a recording of the content embodied in the video signal when the copy preventing signal is detected by the first means.

A method for controlling copy of a video signal using controller 205 when detector 204 determines that a macrovision signal is included in a video signal is described in detail with reference to Fig. 3. A predetermined threshold value C_{th} for determining whether a macrovision signal is included or not in an interval in which a masking pulse is generated is set and stored in a nonvolatile memory (a memory within the detector) in step 301. In other words, the threshold C_{th} is set to exceed the number of horizontal synchronizing signals and to be smaller than or equal to the sum of the number of the horizontal synchronizing signals and the number of macrovision signals in an interval in which a masking pulse is generated.

In step 302, the horizontal synchronizing signals of a composite synchronizing signal are counted to generate a masking pulse for slicing an interval between the 12th and the 19th horizontal synchronizing signals of a first field and an interval between the 275th and the 282nd horizontal synchronizing signals of a second field, on which the macrovision signal is

loaded.

In step 303, the input composite synchronizing signal is sliced using the masking pulse generated in step 302. In other words, only the composite synchronizing signal in the interval in which the masking pulse is generated is output.

In step 304, the horizontal synchronizing signals and the macrovision signals included in the composite synchronizing signal sliced by the masking pulse are counted to obtain count value C_n . When the macrovision signals are not loaded, only the horizontal synchronizing signals included in the composite synchronizing signal are counted.

In step 305, count value C_n is compared with threshold value C_{th} initially set in the step 301.

In step 306, if $C_n \geq C_{th}$, it is determined that the macrovision signal is included, and a recording prevention signal is generated to stop the recording mode. Additionally, an on-screen display message indicating that the recording medium to be copied is protected from copy is displayed.

The copyright can be passively protected from illegal copy by adding a macrovision signal to a video signal as described above. However, dual deck VCRs on the market allow even a video signal including a macrovision signal to be normally copied using an FM copy method (which directly records a modulated video signal read from a recording medium to be copied without demodulating the video signal). To prevent illegal copy of recording medium containing macrovision signals, for example, in the United States, copyrights will

be aggressively protected from April 28, 2000.

The following description concerns an embodiment of the invention in an apparatus and method for controlling copy by applying a method of detecting a copy preventing signal according to the present invention to a dual deck VCR. Referring to Fig. 4, the dual deck VCR to which the present invention is applied includes video heads 401 and 409, rotary transformers 402 and 408, pre-amplifier 403, video signal processor 404, detector 405, FM copy signal processor 406, recording amplifier 407, controller 410, memory 411, timer 412, servo unit 413, drum motor 414, capstan motor 415, display unit 416 and key input unit 417.

Video head 401, rotary transformer 402, video signal processor 404 and detector 405 are included in a reproducing deck VCR, and video head 409, rotary transformer 408, recording amplifier 407, servo unit 413, drum motor 414 and capstan motor 415 are included in a recording deck VCR. Controller 410, memory 411, timer 412, display unit 416 and key input unit 417 are commonly used by the reproducing and recording deck VCRs.

In a normal copy mode, primarily, a recording medium to be reproduced from is loaded on the reproducing deck VCR and a recording medium to be recorded on is loaded in the recording deck VCR. Next, once a user enters a copy command using key buttons in key input unit 417, controller 410 analyzes the input key command and controls the peripheral units such that the reproducing deck VCR performs reproduction and the recording deck VCR performs recording.

More specifically, in video signal processing by the reproducing deck VCR, a video

1 signal detected by the video head 401 is transmitted to pre-amplifier 403 via rotary
2 transformer 402. Pre-amplifier 403 amplifies the input video signal according to a
3 predetermined gain value suitable for signal processing.

4 The video signal amplified by pre-amplifier 403 undergoes signal processing such as
5 demodulation, noise filtering and de-emphasis in signal processor 404. Signal processor 404
6 outputs the signal processed video signal to display unit 416. Simultaneously, FM copy
7 signal processor 406 performs signal processing such as automatic gain control (AGC),
8 limiting signal level and frequency characteristic compensation on the modulated video
9 signal input from the pre-amplifier 403 without demodulation of the modulated video signal.

10 Next, the output signal of FM signal processor 406 is applied to and amplified by
11 recording amplifier 407 of the recording deck VCR and then transmitted to video head 409
12 via rotary transformer 408 so as to be recorded in the recording medium in the recording
13 deck VCR.

14 A method and apparatus for controlling copy in a dual deck VCR on the basis of a
15 beginning data at which copyright is aggressively protected will be described with reference
16 to Figs. 4 and 5.

17 In step 501, initial value T_0 is set by storing data on the beginning date at which
18 copyright is aggressively protected in nonvolatile memory 411.

19 In step 502, it is determined whether a copy command is input to controller 410
20 through key input unit 417.

1 In step 503, controller 410 determines whether timer 412 is reset or not. The capacity
2 of the battery of timer 412 is set such that timer 412 can backup the dates from a current date
3 at least to the date the aggressive protection of copyright becomes effective. Accordingly,
4 in the case in which a set including timer 412 is not sold and not used on the last date on
5 which timer 412 can be backed up, timer 412 is reset after the date. Therefore, when timer
6 412 is reset, it is determined that the aggressive protection of copyright is currently valid.

7 In step 504, when it is determined that timer 412 is not reset in step 503, controller
8 410 compares data T_1 on the date and year read from timer 412 with data T_0 on the beginning
9 date of aggressive protection of copyright set in step 501.

10 When $T_1 \geq T_0$, or when it is determined that timer 412 is reset, it is determined that
11 the aggressive protection of copyright is currently valid. Accordingly, detector 405
12 determines whether a macrovision signal which is a copy preventing signal is detected in step
13 505.

14 In step 506, when the macrovision signal is detected in step 505, controller 410
15 controls the peripheral units so as to stop a copy mode. In other words, controller 410
16 outputs a control signal to servo unit 413 to perform a stop mode. Then, servo unit 413
17 generates and outputs a driving voltage corresponding to the stop mode to drum motor 414
18 and capstan motor 415 to convert an operation mode from the copy mode into the stop mode.

19 In step 507, when the copy mode is stopped, characters informing the user that a
20 recording medium to be copied is protected from being illegally copied are displayed through

1 an on-screen display message. In other words, controller 410 controls character signals
2 stored in the memory 411 to be read to display a message informing the user that the
3 recording medium is protected from illegal copy through display unit 416.

4 When $T_1 < T_0$, or when the macrovision signal is not detected in step 505, a normal
5 copy mode is performed in step 508.

6 Accordingly, the dual deck VCR performs copying regardless of detection of the
7 macrovision signal before the aggressive protection of copyright becomes effective, and
8 stops copy when the macrovision signal is detected after the aggressive protection of
9 copyright becomes effective.

10 As described above, the present invention stops a copy (or recording) mode and
11 informs a user that a recording medium to be copied is protected from illegal copy when a
12 copy preventing signal is detected from a video signal reproduced from the recording
13 medium to be copied, thereby allowing the user to quickly recognize that the recording
14 medium to be copied includes a copy preventing signal before completing the copy. In
15 addition, when the present invention is applied to a dual deck VCR, the FM copy can be
16 controlled depending on the existence/non-existence of a macrovision signal on the basis of
17 the beginning date the aggressive protection of copyright becomes effective, thereby
18 providing convenience to the user and allowing for manufacture of productions without
19 violating copyright laws.

20 While the invention has been described in connection with specific and preferred

embodiments thereof, it is capable of further modifications without departing from the spirit and scope of the invention. This application is intended to cover all variations, uses, or adaptations of the invention, following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice within the art to which the invention pertains, or as are obvious to persons skilled in the art, at the time the departure is made. It should be appreciated that the scope of this invention is not limited to the detailed description of the invention hereinabove, which is intended merely to be illustrative, but rather comprehends the subject matter defined by the following claims.

What is claimed is:

1 1. In an apparatus for controlling copy of content embodied in a video signal, the
2 apparatus comprising a video signal processor for separating a composite synchronizing
3 signal from a content containing input video signal to be recorded and for modulating or
4 demodulating the video signal, *the improvement comprising:*

5 a first means for receiving the composite synchronizing signal and detecting therefrom a
6 copy-preventing signal; and

7 a second means for generating a recording-prevention control signal adapted to stop a
8 recording of the content embodied in the video signal, when a copy-preventing signal
9 is detected by the first means.

1 2. The apparatus of claim 1, wherein the first means comprises:

2 a pulse generator for generating a masking pulse in a predetermined interval of the composite
3 synchronizing signal in which a copy-preventing signal is contained;

4 a first gating means for providing as an output signal the composite synchronizing signal in
5 the interval in which the masking pulse is generated;

6 an integrator for integrating the output signal from the first gating means and for providing
7 as an output an integrated signal, said integrated signal having an output level; and

8 a comparator for comparing the output level of the integrated signal with a predetermined
9 threshold value to determine whether a copy-preventing signal is present in the video

10 signal.

1 3. The apparatus of claim 2, wherein the first gating means includes a second
2 gating means for removing a horizontal synchronizing signal from the composite
3 synchronizing signal in the interval in which the masking pulse is generated.

1 4. The apparatus of claim 1, wherein the first means comprises a means for
2 indicating detection of a copy-preventing signal, when a pulse count value in a predetermined
3 interval of the composite synchronizing signal is equal to or greater than a predetermined
4 threshold value.

1 5. The apparatus of claim 1, wherein the second means also further comprises a
2 means for causing a display of information that the video signal to be copied is copy-
3 protected, when a copy-preventing signal is detected by the first means.

1 6. In a method for controlling copy of content embodied in a video signal, the
2 method comprising the steps of separating a composite synchronizing signal from a content
3 containing video signal to be recorded, and of modulating or demodulating the video signal,
4 the improvement comprising the further steps of:

5 (1) determining whether a copy command has been input;

6 (2) comparing a time T_1 read from a timer with an initially set threshold value T_0 when
7 it is determined in the first step that a copy command has been input;

8 (3) determining whether a copy-preventing signal is present in the video signal to be
9 recorded when it is determined in the second step that $T_1 \geq T_0$; and

10 (4) refraining from copying the content embodied in the video signal when it is
11 determined in the third step that a copy-preventing signal is present in the video signal.

1 7. The method of claim 6, wherein the fourth step further comprises displaying
2 information indicating that the content of the video signal is copy-protected.

1 8. The method of claim 6, wherein the threshold value T_0 is set to a date on which
2 aggressive protection of copyright becomes effective.

1 9. In a method for controlling copy of content embodied in a video signal, the
2 method comprising the steps of separating a composite synchronizing signal from a content
3 containing video signal to be recorded and modulating or demodulating the video signal, the
4 improvement comprising the steps of:

5 (1) determining whether a copy command has been input;

6 (2) when it has been determined that a copy command has been input, determining
7 whether a copy-preventing signal is present in the video signal to be recorded; and

8 (3) refraining from copying the content embodied in the video signal when it is
9 determined in the second step that a copy-preventing signal is present in the video signal.

1 10. In an apparatus for controlling copy of content embodied in a video signal, said
2 apparatus comprising a dual deck video cassette recorder (VCR) having a reproducing deck
3 VCR; a recording deck VCR; an FM copy signal processor for performing automatic gain
4 control and waveform equalization without demodulating a video signal detected by a video
5 head of the reproducing deck VCR; and a video signal processor for demodulating the video
6 signal detected by the video head of the reproducing deck VCR and for separating a
7 composite synchronizing signal from the demodulated video signal;

8 *the improvement comprising*

9 a first means for receiving the composite synchronizing signal and detecting
10 therefrom whether the composite synchronizing signal contains a copy-
11 preventing signal;

12 a second means for generating a recording-prevention control signal when the first
13 means detects that the composite synchronizing signal contains a copy-
14 preventing signal; and

15 a third means for receiving the recording-prevention control signal and thereupon to
16 cause the recording deck VCR not to record the content of the video signal.

1 11. The apparatus of claim 10, wherein the second means generates the recording-
2 prevention control signal only after a date on which aggressive protection of copyright
3 becomes effective.

1 12. The apparatus of claim 10, wherein the second means comprises means for
2 causing display of information that a copy-preventing signal has been detected, when a copy-
3 preventing signal has been detected.

1 13. In a process for manufacturing an apparatus for controlling copy of content
2 embodied in a video signal, the apparatus comprising a video signal processor for separating
3 a composite synchronizing signal from a content containing input video signal to be recorded
4 and for modulating or demodulating the video signal, said process comprising the steps of:

5 (1) providing a first means for receiving the composite synchronizing signal and
6 detecting therefrom a copy-preventing signal; and

7 (2) providing a second means for generating a recording-prevention control signal
8 adapted to stop a recording of the content embodied in the video signal, when the copy-
9 preventing signal is detected by the first means.

1 14. In a process for manufacturing an apparatus for controlling copy of content
2 embodied in a video signal, said apparatus comprising a dual deck video cassette recorder

3 (VCR) having a reproducing deck VCR; a recording deck VCR; an FM copy signal processor
4 for performing automatic gain control and waveform equalization without demodulating a
5 video signal detected by a video head of the reproducing deck VCR; and a video signal
6 processor for demodulating the video signal detected by the video head of the reproducing
7 deck VCR and for separating a composite synchronizing signal from the demodulated video
8 signal, said process comprising the steps of:

9 (1) providing a first means for receiving the composite synchronizing signal and
10 detecting therefrom whether the composite synchronizing signal contains a copy-preventing
11 signal;

12 (2) providing a second means for generating a recording-prevention control signal
13 when the first means detects that the composite synchronizing signal contains a copy-
14 preventing signal; and

15 (3) providing a third means for receiving the recording-prevention control signal and
16 thereupon to cause the recording deck VCR not to record the content of the video signal.

ABSTRACT

An apparatus and method for controlling copy of a video signal is provided for detecting a copy preventing signal, and for stopping recording and informing the user that a video signal to be recorded is protected against copying when a video signal having a copy-preventing signal is detected. In the apparatus and method, a copy (or recording) mode is stopped, and the user is informed that a recording medium to be copied is protected against illegal copying when a copy-preventing signal is detected from a video signal reproduced from the recording medium to be copied, thereby allowing the user to quickly recognize that the recording medium to be copied includes a copy-preventing signal before completing the copy. In addition, when the apparatus and method are applied to a dual deck VCR, FM copy can be controlled depending on whether a macrovision signal exists on the basis of the beginning date on which the aggressive protection of copyright becomes effective.

FIG. 1A

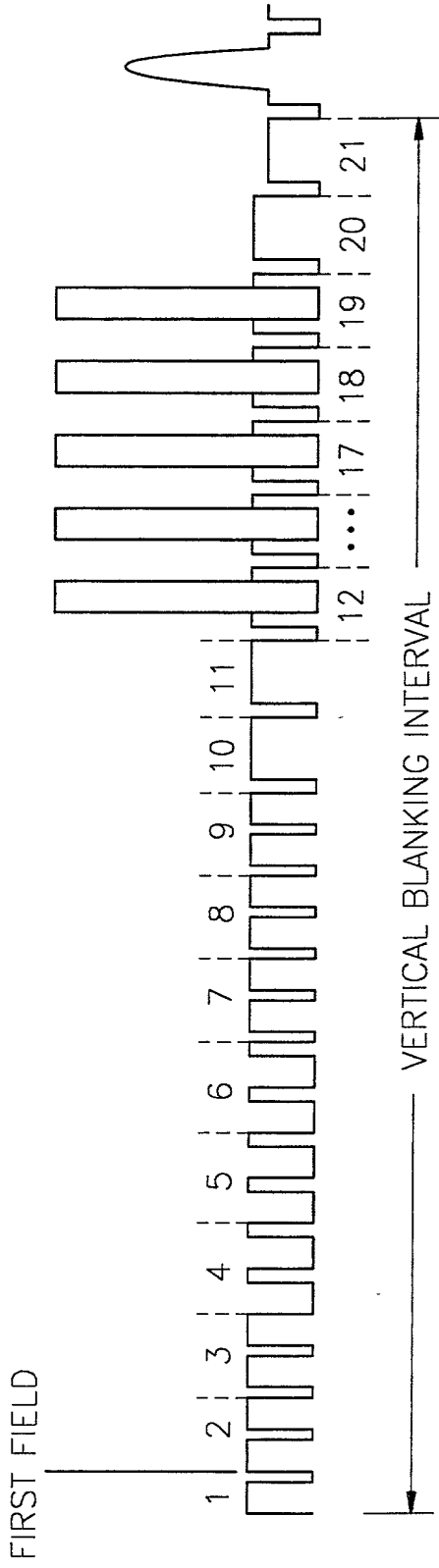


FIG. 1B

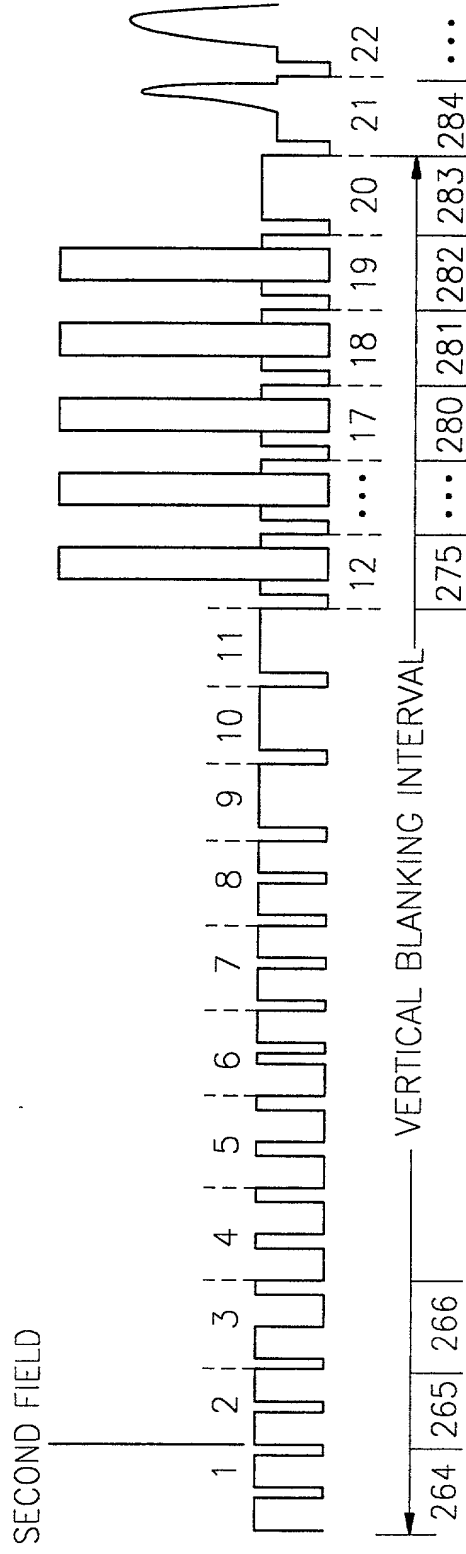


FIG. 2

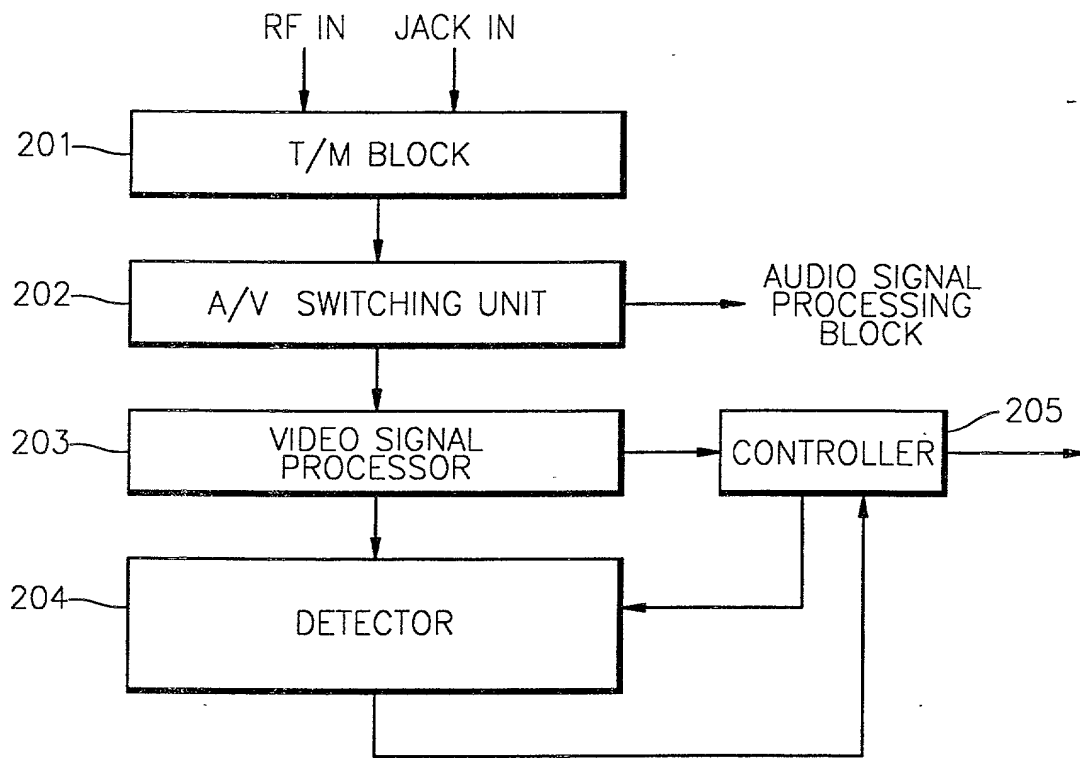


FIG. 3

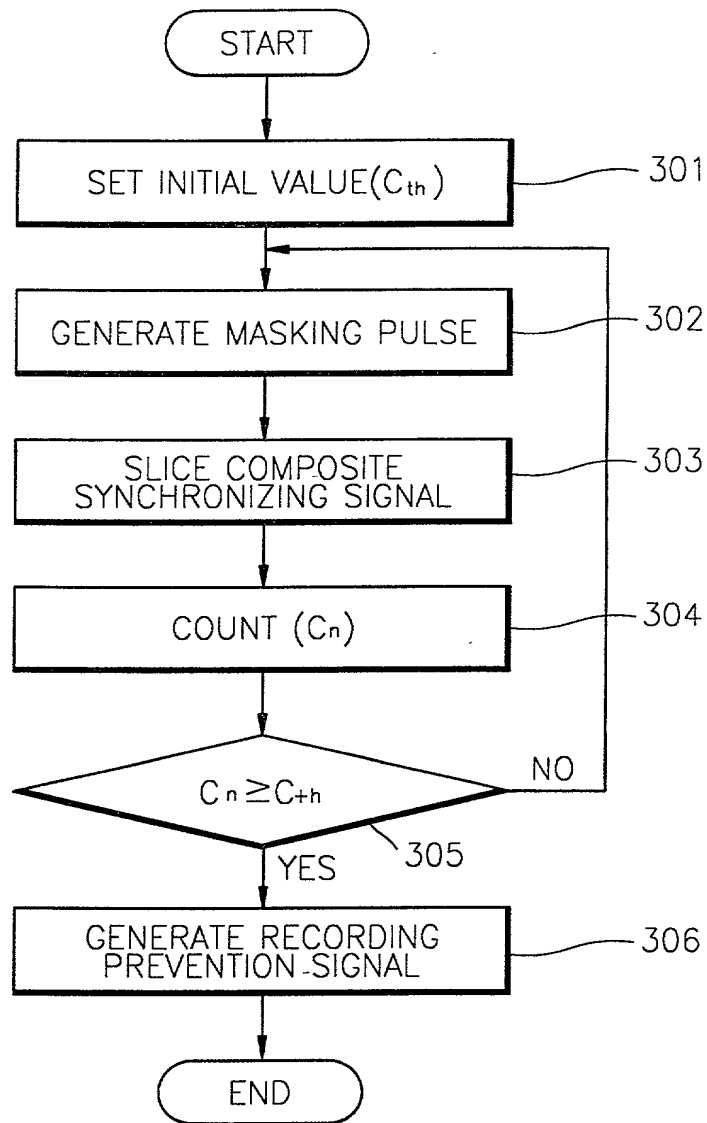


FIG. 4

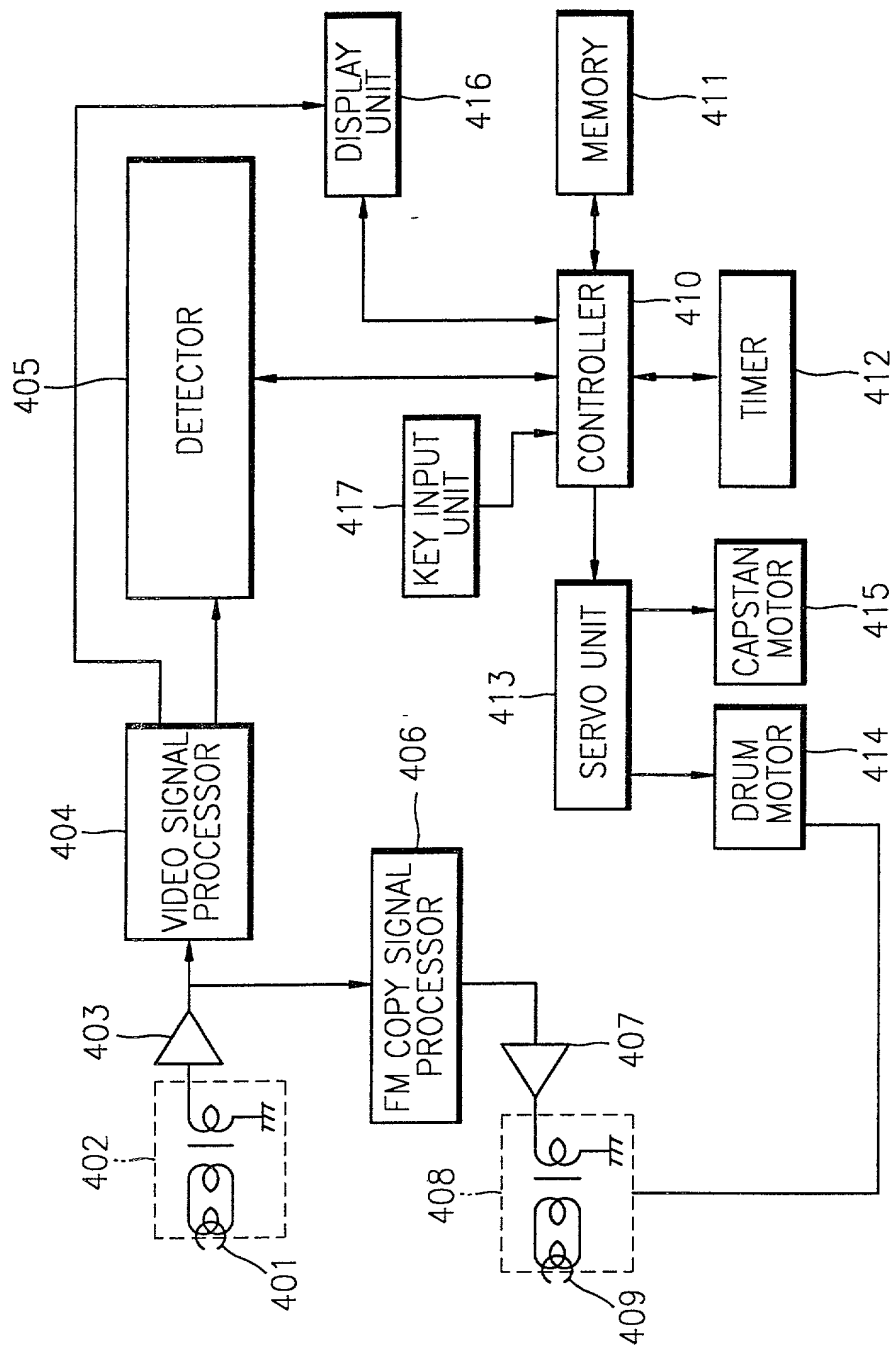
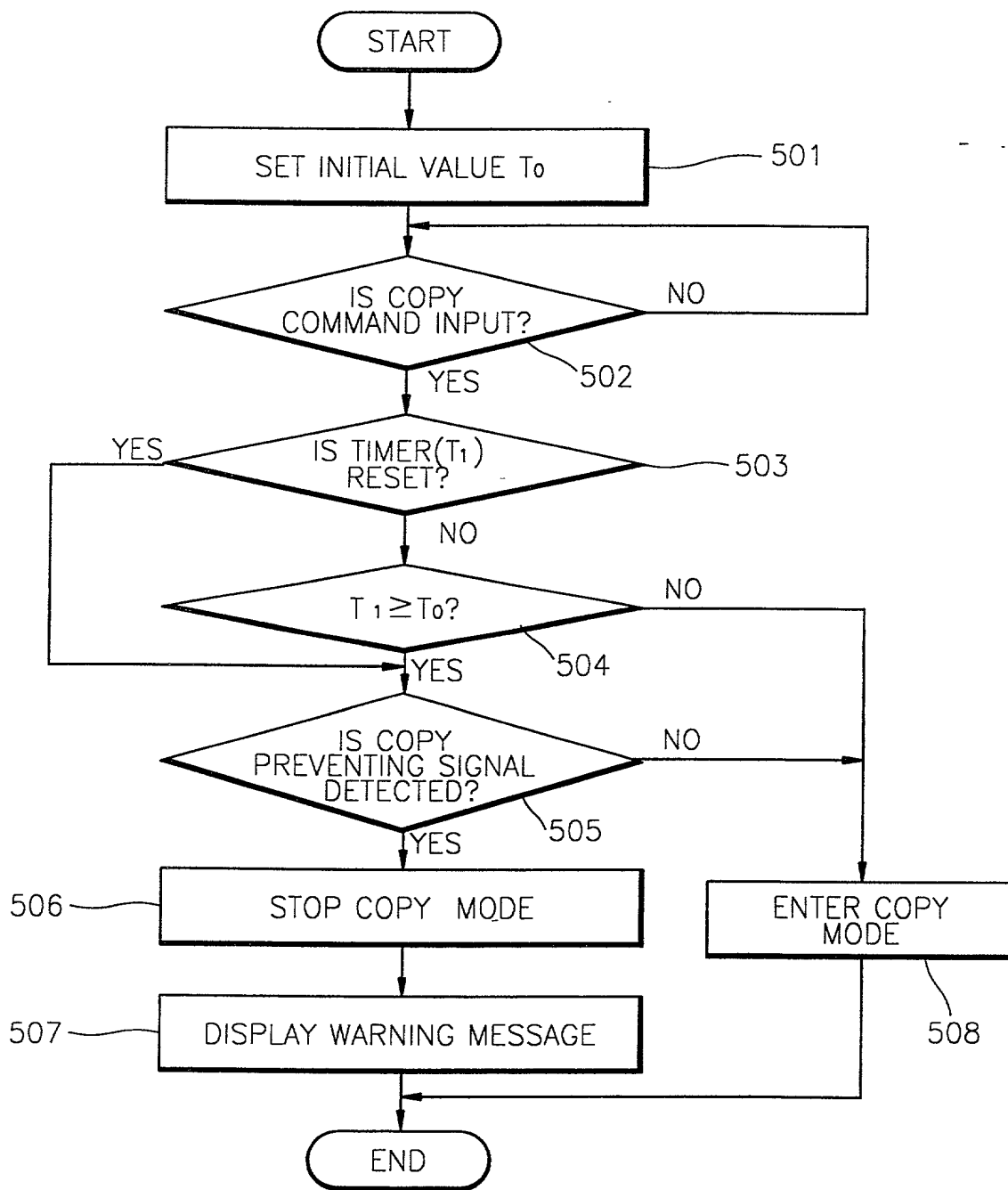


FIG. 5



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

CHANG-ROK LEE et al.

Serial No.: *To be assigned*

Examiner: *To be assigned*

Filed: 30 May 2000

Art Unit: *To be assigned*

For: APPARATUS AND METHOD FOR CONTROLLING COPY OF VIDEO SIGNAL


TRANSMITTAL OF DECLARATION

Assistant Commissioner
for Patents
Washington, D.C. 20231

Sir:

This transmittal accompanies an unexecuted Declaration for the above-captioned application. An executed Declaration will be filed upon receipt of the Serial No. for the above-captioned application.

Respectfully submitted,


Robert E. Bushnell,
Attorney for the Applicant
Registration No.: 27,774

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Date: 5/30/00
I.D.: REB/sb

AS A BELOW NAMED INVENTOR, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe that I am the original, first and sole (*if only one name is listed below*), or an original, first and joint inventor (*if plural names are listed below*), of the subject matter which is claimed and for which a patent is sought on the invention entitled:

TITLE: APPARATUS AND METHOD FOR CONTROLLING COPY OF VIDEO SIGNAL

the specification of which either is attached hereto or otherwise accompanies this Declaration, or:

☐ was filed in the U.S. Patent & Trademark Office on _____ and assigned Serial No. _____,

☐ and (*if applicable*) was amended on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above. I acknowledge the duty to disclose information which is material to patentability and to the examination of this application in accordance with Title 37 of the Code of Federal Regulations §1.56. I hereby claim foreign priority benefits under Title 35, U.S. Code §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, or §119(e) of any United States provisional application(s), listed below and have also identified below any foreign applications for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

19771/1999	Republic of Korea	31 May 2000	Priority Claimed:
(Application Number)	(Country)	(Day/Month/Year filed)	Yes [X] No []
			Yes [] No []
(Application Number)	(Country)	(Day/Month/Year filed)	

I hereby claim the benefit under Title 35, U.S. Code, §120, of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application(s) in the manner provided by the first paragraph of Title 35, U.S. Code, §112, I acknowledge the duty to disclose information material to patentability as defined in Title 37, The Code of Federal Regulations, §1.56(a) which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(STATUS: patented, pending, abandoned)
(Application Serial No.)	(Filing Date)	(STATUS: patented, pending, abandoned)

I hereby revoke all previously granted powers of attorney and appoint the following attorneys: Robert E. Bushnell, Reg. No. 27,774, Michael D. Parker, Reg. No. 34,973, and Darren R. Crew, Reg. No. 37,806, to prosecute this application and to transact all business in the U.S. Patent & Trademark Office connected therewith and with any divisional, continuation, continuation-in-part, reissue or re-examination application, with full power of appointment and with full power to substitute an associate attorney or agent, and to receive all patents which may issue thereon, and request that all correspondence be addressed to:

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I HEREBY DECLARE that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 U.S. Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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FULL NAME OF THIRD JOINT INVENTOR: _____ Citizenship: _____

Inventor's signature: _____ Date: _____
Residence & Post Office Address: _____

FULL NAME OF FOURTH JOINT INVENTOR: _____ Citizenship: _____

Inventor's signature: _____ Date: _____
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☐ Additional inventors are being named on separately numbered sheets attached hereto.